Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, DC

TSO-C159

Effective Date:
9/20/04

Technical Standard Order

Subject: TSO-C159, AVIONICS SUPPORTING NEXT GENERATION SATELLITE SYSTEMS (NGSS)

1. PURPOSE. This Technical Standard Order (TSO) is for manufacturers of Next Generation Satellite Systems (NGSS) applying for a TSO authorization or letter of design approval. In it, we tell you what minimum performance standards (MPS) your NGSS systems and equipment must first meet for approval and identification with the applicable TSO marking.

2. APPLICABILITY. This TSO affects new applications submitted after this TSO's effective date.

3. REQUIREMENTS. New models of NGSS equipment identified and manufactured on or after the effective date of this TSO must meet the MPS in RTCA Document No. (RTCA/DO)-262, "Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS)," Sections 2, dated December 14, 2000 and Change No. 1 to RTCA/DO-262 dated November 28, 2001.

a. Functionality. This TSO's standards apply to equipment intended to provide Aeronautical Mobile Satellite (R) Services (AMS(R)S) by means of satellite communications between Aircraft Earth Stations (AES), corresponding satellites, and Ground Earth Stations (GES). The NGSS will support both data and voice communications between aircraft users and ground-based users, such as Air Route Traffic Control Centers (ARTCCs) and aircraft operators.

(1) Communication services supported by NGSS functionality include two safety of flight and two non-safety of flight communication service categories, respectively: Air Traffic Services (ATS), Aeronautical Operational Control (AOC), Aeronautical Administrative Communication (AAC), and Aeronautical Passenger Communications (APC).

(2) NGSS equipment is intended for oceanic and remote area operations. We determine the failure condition specified in paragraph **3b** based upon NGSS equipment operating in oceanic and remote area environments. Intended use of NGSS equipment in alternative operating environments (for example, high density terminal/en route domestic airspace) may impact equipment performance and safety considerations. These alternate operating environments will require us to reassess the failure condition classification in paragraph **3b**.

b. Failure Condition Classification. Failure of the function defined in paragraphs **3** and **3a** of this TSO is a minor failure condition. You must develop the system to, at least, the design assurance level equal to this failure condition classification.

c. Environmental Qualification. Test the equipment according to RTCA/DO-160D, "Environmental Conditions and Test Procedures for Airborne Equipment," dated July 29, 1997, including Change 1, dated December 14, 2000, Change 2, dated June 12, 2001, and Change 3, dated December 5, 2002.

d. Software Qualification. If the article includes a digital computer, develop the software according to RTCA/DO-178B, "Software Considerations in Airborne Systems and Equipment Certification," dated December 1, 1992.

e. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety and must apply for a deviation as required by Title 14 of the Code of Federal Regulations (14 CFR) § 21.609.

4. MARKING. Under 14 CFR § 21.607(d), mark articles manufactured under this TSO as follows:

a. Permanently and legibly, mark at least one major component with all the information in 14 CFR § 21.607(d), except for:

(1) 14 CFR § 21.607(d)(2): Where you must use the name, type and part number of the article, in lieu of the optional model number; and

(2) 14 CFR § 21.607(d)(3): Where you must use the date of manufacture instead of the optional serial number, when the date of manufacture is critical for maintenance or inspections determinations.

b. In addition to **4a,** permanently and legibly, mark an interchangeable element, separate sub-assembly, or each separate component that is easily removable (without hand tools), with at least the name of the manufacturer, manufacturer's part number, and the TSO number.

c. The part number must include hardware and software identification if the component includes a digital computer. You may use a separate part number for hardware and software. Either approach must include a way to show the modification status. Different part numbers may differentiate similar software versions approved to different software levels.

d. When applicable, identify the equipment as an incomplete system or that the appliance performs functions beyond those described in paragraphs **3** and **3a** of this TSO.

5. APPLICATION DATA. Under 14 CFR § 21.605(a)(2), manufacturers must give the FAA Aircraft Certification Office (ACO) manager responsible for their facilities one copy each of the following technical data to support the FAA design and production approval:

a. Operating instructions and equipment limitations, sufficient to describe the operational capability of the equipment. In particular, you must describe in detail operational or installation limitations resulting from specific deviations granted.

b. Installation procedures and limitations, sufficient to ensure that the NGSS equipment, when installed according to the installation procedures, continues to meet this TSO requirements. The limitations must identify any unique aspects of the installation. Finally, the limitations must include a note with the following statement:

> The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standard. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

c. Schematic drawings of the installation procedures.

d. Wiring diagrams of the installation procedures.

e. List of components, by part number, that make up the NGSS complying with the standards prescribed in this TSO. Manufacturers should include vendor part number cross-references, when applicable.

f. A Component Maintenance Manual (CMM), containing information on the periodic maintenance, calibration, and repair, for the continued airworthiness of installed NGSS. The CMM should include recommended inspection intervals and service life. Also, in the CMM, you may describe details of deviations granted, as noted in paragraph **5a** of this TSO.

g. Material and process specifications list.

h. The quality control system description required by 14 CFR §§ 21.605(a)(3) and 21.143(a), including functional test specifications to be used to test each production article to ensure compliance with this TSO.

i. Manufacturer's TSO qualification test report.

j. Nameplate drawing providing the information required by paragraph **4** of this TSO.

k. A list of all drawings and processes, including revision level, necessary to define the article's design. In the case of a minor change, any revisions to the drawing list need only be made available on request.

l. An environmental qualifications form described in RTCA/DO-160D for each component of the system.

m. If the article includes a digital computer: a Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary. We recommend that the manufacturer submit the PSAC early in the software development process. Early submittal will allow us to quickly resolve issues, such as partitioning and determination of software levels.

6. MANUFACTURER DATA. Besides the data to be furnished directly to the FAA, each manufacturer must have available for review by the manager of the ACO responsible for the manufacturer's facilities the following technical data:

a. The functional qualification specifications to be used to qualify each production article to ensure compliance with this TSO.

b. Equipment calibration procedures.

c. Corrective maintenance procedures within 12 months after TSO authorization.

d. Schematic drawings.

e. Wiring diagrams.

f. Material and process specifications.

g. The results of the environmental qualification tests conducted per RTCA/DO-160D.

h. If the article includes a digital computer, the appropriate documentation as defined in RTCA/DO-178B, including all data supporting the applicable objectives in Annex A of RTCA/DO-178B.

7. FURNISHED DATA. If furnishing one or multiple articles to one source (such as an operator or repair station), provide the following for each article manufactured under this TSO:

a. One copy of the technical data and information specified in paragraphs **5a** through **5f** of this TSO and any other data or information necessary for the proper installation, certification and use or continued airworthiness of the NGSS.

b. If the appliance performs functions beyond those described in paragraphs **3** and **3a** of this TSO, then a copy of the data and information specified in paragraphs **5k** through **5m**.

8. HOW TO GET REFERENCED DOCUMENTS.

a. You can buy copies of RTCA Documents from the RTCA Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, DC 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also get copies through the RTCA Internet website at www.rtca.org.

b. You can buy copies of 14 CFR part 21, Subpart O, from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325. Telephone (202)

512-1800, Fax (202) 512-2250. You can also get copies from the Government Printing Office (GPO), electronic CFR Internet website at www.access.gpo.giv/ecfr/.

c. You can get FAA Advisory Circular (AC) 20-110, "Index of Aviation Technical Standard Orders" or the most current revision, and AC 20-36, "Index of Articles Certified Under Technical Standard Order System" or the most current revision, from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785. Telephone (301) 322-5377, fax (301) 386-5394. You can also get copies from our Regulatory and Guidance library at www.airweb.faa.gov/rgl. On the RGL webpage, select "Advisory Circulars."

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